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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/533,920

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Carl Towns

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2378

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7590

10/22/2008

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EXAMINER

NELSON, MICHAEL E

ART UNIT

PAPER NUMBER

1794

MAIL DATE

DELIVERY MODE

10/22/2008

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/533,920

Applicant(s)

TOWNS ET AL.

Examiner

MICHAEL E. NELSON

Art Unit

1794

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 01 August 2008.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SF/ICE)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Status of Claims

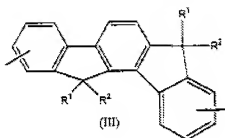
1. Claims 1-24 are pending. Claims 6, 17-18, 20 and 21 have been amended. No claims have been cancelled.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-12 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Becker et al. (WO 01/42331) in view of Setayesh et al. (Journal of the American Chemical Society, vol. 123, no. 5, pp. 946-953, 2001).
4. Concerning claims 1-4, Becker et al. describe polymer materials comprising a repeat unit having the structure shown below, where R¹ and R² are the same or different from each other and are selected from the group consisting of hydrogen, alkyl, haloalkyl, alkoxy, alkoxyalkyl, **aryl**, and aralkyl. (page 4) Aryl substituents are defined as aromatic hydrocarbon groups having from 6 to 14 carbon atoms in one or more rings, which may be optionally substituted by at least one substituent selected from nitro, cyano, amino, alkyl, haloalkyl, alkoxyalkyl, aryloxy, and alkoxy groups. As such, Becker et al. describe materials with at least 2 or at least 4 aryl groups (per claims 2-4).



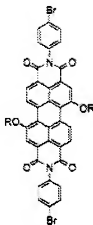
5. Concerning claim 5, Becker et al. describe the polymer material discussed above, but are silent on the condition where R¹ and R² on one ring are alkyl, and where R¹ and R² on the other ring are aryl. However, given the teaching that alkyl and aryl substituents are suitable at those positions, it would have been obvious to one of ordinary skill in the art to use a material where one ring had alkyl substituents and one ring had aryl substituents, since the resulting material would be predicted to function in the same manner as an electroluminescent polymer material.

6. Concerning claims 6-7, Becker et al. disclose that the substituents may be aryl groups with 6-14 carbon atoms, with substituents including alkyl groups, where the alkyl groups are straight or branched chain alkyl groups having from 1 to 20 carbon atoms. (page 5) Given this teaching, it would have been obvious to one of ordinary skill in the art to use a phenyl substituent (a 6 carbon aryl group, per claim 6) with an alkyl substituent at the 4 position on the phenyl ring (including octyl, or t-butyl, well known alkyl substituents, per claim 7), since the resulting material would be predicted to function in the same manner.

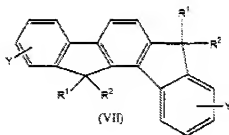
7. Concerning claims 8-9, Becker et al. describe the polymer materials discussed above, and disclose the incorporation of a second repeat unit (per claim 8), specifically

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a perylene unit, including subunits having the structure shown below (heteroaromatic, per claim 9) .(page 13).



8. Concerning claim 10-11, Becker et al. describe monomers for the synthesis of the polymer material from a monomer having the formula shown below, where R^1 and R^2 are the same as described above, and Y is a group capable of leaving as a nucleophile (polymerizable group, per claim 10) (page 12), specifically including halogen atoms (per claim 11), triflate groups, and mesylate groups, and preferably bromine (halogen). (page 13)



9. Concerning claims 12, Becker et al. describe the synthesis of the polymer material described above by reacting the monomer shown above with a second

monomer, generally under Yamamoto-coupling protocols, where both monomers are di-halogen compounds (page 14).

10. Concerning claim 14, Becker et al. describe the use of the polymer material discussed above as the light emitting material in an organic light emitting device. (abstract).

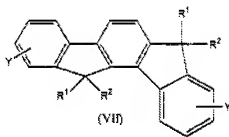
11. Becker et al. does not explicitly disclose the material discussed above, but it would have been obvious to one of ordinary skill to make such a material given the general teaching, and providing the motivation provided by Setayesh et al., who describes polymer materials such as alkyl-polyfluorenes and alkyl-polyindenofluorenes, and discuss their tendencies to aggregate, reducing their efficiency. Setayesh et al. disclose the use of bulky aromatic substituents in the 9 position of the fluorene monomer to reduce aggregation, including t-butylphenyl substituents (see scheme 5, page 950). Given the teaching that bulky aromatic substituents on fluorene prevent aggregation of the polymer materials, a common problem with indenofluorene polymers, it would have been obvious to one of ordinary skill in the art to make polyindenofluorenes with aryl substituents to reduce polymer aggregation.

12. Claims 15-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Becker et al. (WO 01/42331) in view of Towns et al. (6,353,072).

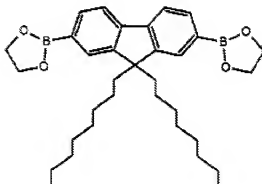
13. Concerning claims 15-19, Becker et al. describe the polymer material discussed above, comprising an indenofluorene monomer unit. Becker et al. disclose the process for producing the polymer material by polymerization of a monomer unit having the

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structure shown below where Y is a leaving group, generally halogen, triflate or mesylate. (page 13) The polymer is formed by Yamamoto polymerization, as shown on page 14, or by Suzuki polymerization (page 15).



14. The Suzuki reaction is a well known process by which a halogenated material is reacted with a boronic acid or boronate ester. The analogous polymerization reaction is described by Towns et al. whereby a polymer is produced from (a) an aromatic monomer having at least two reactive boron derivative groups selected from a boronic acid, boronic ester and a borane group, and an aromatic monomer having at least two reactive halide functional groups, or (b) an aromatic monomer having one reactive halide functional group and one reactive boron derivative group with a catalytic amount of palladium catalyst (suitable catalyst, per claim 20), and an organic base in an amount sufficient to convert the reactive boron derivative groups into -B(OH)_3^- anions (boronate anionic groups, per claim 20). (abstract, column 3, lines 31-44) Towns describes by example boronic acid esters having a cyclic structure illustrated by the compound below (where presently claimed $\text{R}_{12}\text{-R}_{15}$ are alkyl, and are linked to form an ethylene group).



15. Conversion of the dihalide described by Becker et al. to the di-boronate, analogous to the compound shown above is trivial, and would have been obvious to one of ordinary skill in the art to make a boronated monomer unit for use in a Suzuki polymerization reaction, according to the method described by Towns et al. since the reaction would be predicted to function in the same way, and produce the same polymer material as the Yamamoto polymerization described by Becker et al.

16. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Becker et al. (WO 01/42331) and Setayesh et al. (Journal of the American Chemical Society, vol. 123, no. 5, pp. 946-953, 2001) as applied to claim 1 above, and further in view of Towns et al. (6,353,072).

17. Concerning claim 13, Becker et al. describe the process for making the polymer material discussed above, by polymerization of a di-halogenated compound. However, Becker et al. also discloses the use of Suzuki polymerization to produce the polymer material. The Suzuki polymerization requires the use of at least one boronic acid substituted monomer unit, as discussed above in paragraph 23. The conversion of a di-

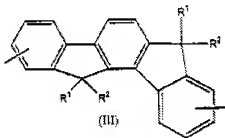
halogenated compound to a di-boronic acid or boronic ester is trivial. Given the teaching by Becker et al. for the use of the Suzuki polymerization method, it would have been obvious to one of ordinary skill in the art to produce the polymer described above, where at least one of R¹ and R² is aryl, by a Suzuki polymerization, essentially the polymerization of a monomer where each P is a boron derivative, and another monomer having two halogens or sulfonate ester, or where each P is a halogen or sulfonate ester, the other monomer is a di-boronate, or where the single monomer has both a halogen and a boronate functionality as discussed above. The process would be predicted to work in the same way as that described by Towns et al., and would produce the same polymer material as described by Becker et al.

18. Claims 21-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sirringhaus et al. (WO 0079617) in view of Becker et al. (WO 01/42331).

19. Concerning claims 21-23, Sirringhaus et al. describes field effect transistors (switching devices, per claim 21) comprising a gate insulator having a first side and second side, a gate electrode located on the first side of the insulator, a semiconducting polymer located on the second side of the insulator and a drain electrode and source electrode located on the polymer. (figure 4) Sirringhaus et al. further describes logic circuit (integrated circuit) comprising the transistor (claim 30). The semiconducting polymer is a block copolymer comprising a first block which may be an indenofluorene derivative, and a second block that increases the electron affinity of the copolymer, including benzothiadiazoles, and **perylene** derivatives. (page 20, final paragraph)

Sirringhaus et al. are silent on the use of the specific polymer composition of the polymer.

20. Becker et al. describe polymer materials comprising a repeat unit having the structure shown below, where R^1 and R^2 are the same or different from each other and are selected from the group consisting of hydrogen, alkyl, haloalkyl, alkoxy, alkoxyalkyl, **aryl**, and aralkyl. (page 4) Aryl substituents are defined as aromatic hydrocarbon groups having from 6 to 14 carbon atoms in one or more rings, which may be optionally substituted by at least one substituent selected from nitro, cyano, amino, alkyl, haloalkyl, alkoxyalkyl, aryloxy, and alkoxy groups. As such, Becker et al. describe materials with at least 2 or at least 4 aryl groups..



21. Becker et al. describes the polymers discussed above, which are copolymers of the indenofluorene structure above, and perylene derivatives, similar to those disclosed by Sirringhaus et al. Becker et al. further discloses that the polymers show excellent film forming properties, are thermally very stable and can be easily solution processed. (page 1)

22. Given the description by Sirringhaus et al. of an indenofluorene-peryene copolymer such as the one described by Becker et al., it would have been obvious to

one of ordinary skill in the art to use the polymeric material described by Becker et al. as the semiconducting material in the thin film transistor (switching device) as described by Sirringhaus et al. since the material would be predicted to function in the same way given the close structural similarity, and the benefit of having excellent film forming properties, high thermal stability and solution processability.

23. Claim 24 rejected under 35 U.S.C. 103(a) as being unpatentable over Becker et al. (WO 01/42331) and Setayesh et al. (Journal of the American Chemical Society, vol. 123, no. 5, pp. 946-953, 2001) as applied to claim 1 above, and further in view of Inbasekaran et al. (6,353,083).

24. Concerning claim 24, Becker et al. describe the polymer material discussed above, while Setayesh et al. provides motivation for incorporating aryl substituents to reduce aggregation in an electronic device. Becker et al. is silent on the use of the material in a photovoltaic cell. However, it is commonly known to use organic electroluminescent polymers in both electroluminescent devices and in organic photovoltaic cells, since the physical processes are reversible, and a material which can emit light under electrical stimulation can also produce an electric current under photostimulation.

25. Inbasekaran et al. describe polymeric materials and their use in both electroluminescent devices and photovoltaic devices. (see column 7, lines 13-16, and 44-45 and 48-49)

26. Therefore, it would have been obvious to one of ordinary skill in the art to use the polymeric material described by Becker et al. in an organic photovoltaic device since it would be predicted to function as an organic semiconductor and produce electricity upon photostimulation.

Response to Arguments

27. Rejections under 35 U.S.C. 112, 2nd paragraph are withdrawn in light of Applicant's amendments.

28. Double patenting rejections are withdrawn with the filing and acceptance of a valid terminal disclaimer.

29. Applicant has provided a declaration under Rule 1.132 to show that the polymers of the present invention have an improved glass transition temperature compared with polymers described previously. As shown in the table, the glass transition temperature of the polymer materials increases, whether one, two, three, or all four of the alkyl substituents on the indenofluorene component of the polymer are replaced with 4-t-butylphenyl substituents. The data in the declaration is not persuasive given that while the declaration supports the scope of the claims where "at least one of R₁, R₂, R₃, and R₄" is substituted, the declaration does not necessarily support the scope that the substituent is simply an aryl or heteroaryl groups. In each example of the declaration, the alkyl substituent of the prior art indenofluorene monomer is replaced with a 4-t-butylphenyl group, a bulky branched-alkyl substituent. The increase in glass transition temperature illustrates a resistance of the polymer material to crystallization at higher

temperature. As such, it indicates a decrease in the formation of the intermolecular interactions which promote crystallization by the incorporation of a larger substituent. However, the 4-t-butylphenyl group is significantly larger in size than a non-substituted phenyl substituent. Since the unexpected result is based upon a steric property, the fact that the improved examples have a large branched substituent prevents, and the fact that no smaller substituents are presented prevents, the reasonable extrapolation of the results to a non-substituted aromatic substituent without further evidence. Likewise, the linear 4-octylphenyl substituent of claim 7 is sufficiently different in steric bulk from a t-butyl substituent, since it is not a branched structure, that the result cannot be reasonably extrapolated to include that particular substituent either. A showing that the improvement in glass transition temperature was not dependent on the nature of the substituent on the aromatic ring would be required to support the scope of the claims as written.

Conclusion

30. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not

mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MICHAEL E. NELSON whose telephone number is (571)270-3453. The examiner can normally be reached on M-F 7:30am-5:00pm EST (First Friday Off).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Callie Shosho can be reached on 571-272-1123. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Michael E. Nelson
Examiner
Art Unit 1794

/Callie E. Shosho/
Supervisory Patent Examiner, Art Unit 1794